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IN-HARDSTAND TACTICAL VEHICLE MAINTENANCE FACILITIES--CONCEPT D--ETC(U)
MAR 79 R FILECCIA, J BENSON, J MATHERLY

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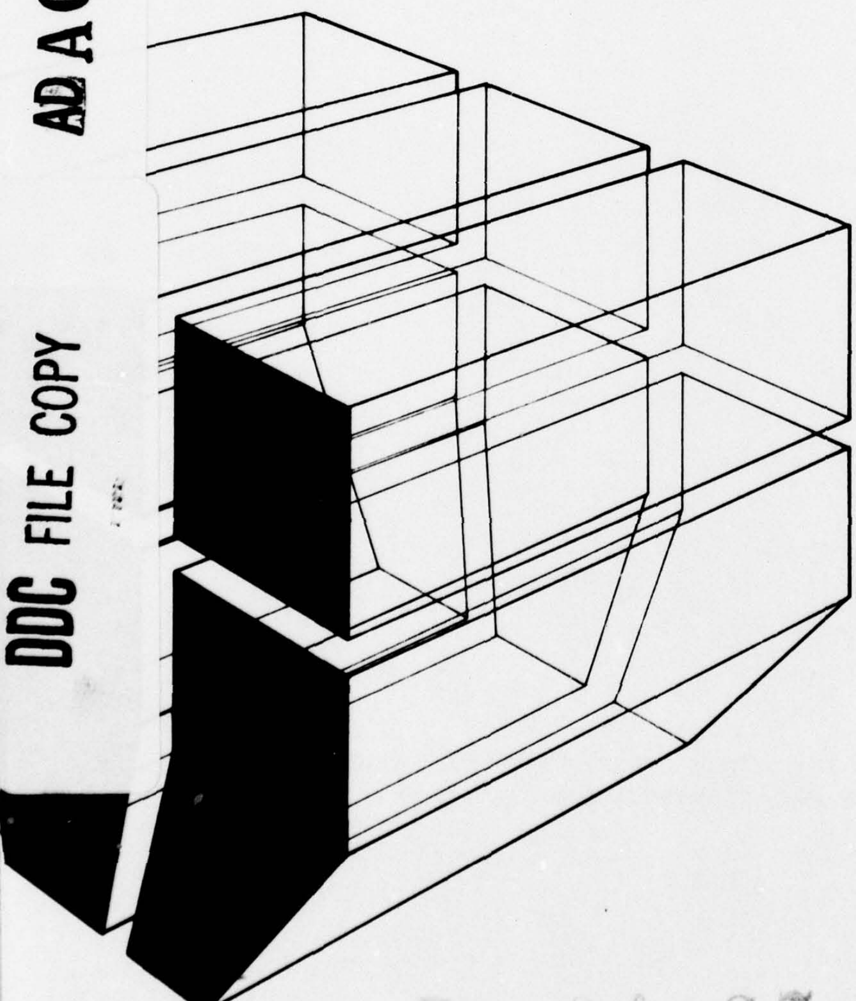
March 1979
Oil Pollution Control at Military Installations

IN-HARDSTAND TACTICAL VEHICLE MAINTENANCE FACILITIES—CONCEPT DESIGN AND PRELIMINARY RECOMMENDATIONS FOR WASTEWATER TREATMENT



by
R. Fileccia
J. Benson
J. Matherly

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Maintenance performed on Army tactical equipment -- defined in terms of oil changing and vehicle cleaning -- was reviewed and several alternative plans for controlling waste discharge from Army motor pool vehicle washing and cleaning were considered.

1. Pretreatment of waste discharges from existing washracks and motor pool shop drains with effluent discharge to sanitary sewers. cont'

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2. Provision of a separate, industrial waste-collection system with centralized treatment of collected wastewater.

3. Replacement of the existing washrack system with one or two consolidated tactical vehicle wash facilities that have centralized wastewater treatment for discharge or recycle.

Alternative 3 was selected as having the most potential for providing an efficient means to regulate effluent discharge. Based on this consideration, concept designs for in-hardstand maintenance facilities were developed. In addition, preliminary recommendations for the design of wastewater pretreatment units were developed, under the assumed condition that gravity separation alone would be sufficient to regulate effluent discharge to an installation's sanitary sewer system.

FOREWORD

This report was prepared for the Directorate of Military Programs, Office of the Chief of Engineers (OCE), under Project 4A762720A896, "Environmental Quality for Construction and Operation of Military Facilities"; Task Area 02, "Pollution Abatement Systems"; Work Unit 009, "Oil Pollution Control at Military Installations." The applicable QCR is 3.01.004. The OCE Technical Monitor was Mr. A. P. Norwood.

The report was prepared by the Environmental Division (EN) of the U.S. Army Construction Engineering Research Laboratory (CERL).

Dr. R. K. Jain is Chief of EN, COL J. E. Hays is Commander and Director of CERL, and Dr. L. R. Shaffer is Technical Director.

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IN-HARDSTAND TACTICAL VEHICLE MAINTENANCE FACILITIES -- CONCEPT DESIGN AND PRELIMINARY RECOMMENDATIONS FOR WASTEWATER TREATMENT

1 INTRODUCTION

Background

Oily wastewater from motor pool operations originates principally from the improper handling and storage of new and waste oils, from vehicle and equipment washing operations, and from various other maintenance activities that generate liquid waste or wastewater which must be stored or treated. Results of a survey[1] conducted in FY77 on oil pollution control problems at Army installations focused on the need for an improved means of handling tactical equipment waste oils. The study determined that maintenance-type cleaning operations performed on existing washrack facilities required the use of a variety of solvents, industrial and domestic cleaners and detergents, and diesel fuels. Since, under present operating conditions, both motor pool shop drainage and washrack discharges are generally directed to storm water collection systems with little or no treatment, it is impossible to achieve the effluent limitations placed on these discharges by regulatory authorities.

There are several alternative plans for controlling waste discharges from motor pool vehicle washing and maintenance cleaning activities:

1. Pretreatment of waste discharges from existing washracks and motor pool shop drains with effluent discharge to the sanitary sewer.

2. Provision of a separate, industrial waste-collection system with centralized treatment of collected wastewater.

3. Replacement of the existing washrack systems with one or two consolidated tactical vehicle wash facilities that have centralized wastewater treatment for discharge or recycle.[2] Maintenance and inspection cleaning functions would be performed within existing shop

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[1] Survey of Oil Pollution Control Problems at Army Installations, Draft Engineer Technical Note (Office of the Chief of Engineers [OCE], 1977).

[2] Consolidated Facilities for Washing Tactical Vehicles, Engineer Technical Note No. 77-14 (OCE, 10 August 1977).

buildings or at a small washrack or maintenance cleaning facility within the hardstand area.

Implementation of the washrack consolidation plan ideally would segregate waste sources; i.e., it would separate dilute high-volume washing wastes from concentrated, low-volume maintenance cleaning wastes, if the latter were produced using low-volume cleaning equipment within existing buildings. It is probable, however, that many existing shops cannot handle the maintenance requirements of the vehicles assigned to them, either because of physical size or facility limitations, or because of their present methods of operation. Retrofitted maintenance facilities as described in this report can be used to expand a given shop's maintenance cleaning capability.

Objective

The objective of this report is (1) to describe concept plans for providing improved waste oil handling and maintenance cleaning capability for tracked and wheeled equipment as retrofit facilities for existing shops, and (2) to make preliminary recommendations for wastewater treatment of projected discharges from these facilities.

Approach

This report details a preliminary control concept study which was conducted in the following steps:

1. Activities which comprise Army motor pool tactical maintenance were defined, maintenance schedules determined, and major maintenance differences between tracked and wheeled equipment were identified.

2. A method to determine the amount of waste oil generated at any given Army motor pool was devised. The relative magnitude of the quantity of waste oils produced by various units, as well as the crankcase and transmission oil capacities of various wheeled and tracked equipment was determined.

3. Existing oil-changing facilities and waste oil and storage equipment were surveyed and the nature of the effluents produced by these facilities determined.

4. Concept designs for in-hardstand maintenance for tracked and wheeled equipment were developed; operational sequences for these facilities were developed.

5. Waste oil storage facilities for use with the proposed in-hardstand maintenance shops were designed, including consideration of various methods of wastewater treatment. A prototype test facility will be

constructed to study wastewater characterization and treatability and to refine proposed design criteria.

Mode of Technology Transfer

Design criteria for the mitigation of oil-contaminated wastewaters at tactical vehicle maintenance areas will be published in an Engineer Technical Letter.

2 DESCRIPTION OF MOTOR POOL MAINTENANCE OPERATIONS AND EXISTING FACILITIES

In this report, tactical vehicle maintenance operations are defined as the changing of crankcase, transmission, and final drive oils; the changing of filters; greasing operations; radiator flushing; and the cleaning of engines, engine packs, engine compartments, wheeled vehicle undercarriages, gun tubes, etc., for the purpose of maintenance, inspection, or repair. Within a given motor pool at an installation, the number and diversity of these operations depends principally on (1) the number and type of tactical vehicles assigned to the unit occupying the shop, (2) the order or level of maintenance to be carried out by the unit, and (3) the frequency of vehicle usage and equipment breakdown.

Operating Procedures and Frequency

Operating procedures for maintaining tactical equipment vary significantly with the type of equipment being processed. In general, however, these procedures can be categorized in terms of maintenance performed on tracked and wheeled equipment, since the major differences in methods of oil changing and cleaning occur between these equipment types.

Tracked Equipment

Maintenance operations performed on tracked equipment are relatively complex compared to those for wheeled equipment, and represent the greater pollution-control problem. In general, the engine and transmission oils of tracked equipment are changed by removing the engine pack (integral engine and transmission) from the vehicle using either an overhead traveling crane or retriever-type equipment. Oils from the final drives, which are adjacent to the drive sprockets of the track assemblies, are also removed. In addition, the engine packs and engine compartments are steam cleaned or hose washed -- generally with the aid of solvents or detergents. The engine pack is then either reunited with the vehicle or returned to the shop for further work.

The frequency at which maintenance is scheduled depends on the type of tracked equipment being processed. For example, the following is the scheduled maintenance frequency for tracked equipment comprising an armored batallion:

Tanks. Tanks are maintained by platoon (six vehicles) on a quarterly basis. However, only two of these quarters reportedly involve the changing of vehicle oils and the cleaning of engine packs and engine compartments.

Armored Personnel Carriers. For these vehicles, engine and transmission oils are changed annually or every 750 miles. For water-cooled equipment, engine coolant is changed annually or as required.

Other Tracked Equipment. Engine and transmission oils are changed twice annually. Engine coolant, where used, is changed annually or as required.

Wheeled Equipment

Wheeled equipment is subject to three scheduled maintenance operations annually. Engine oils are changed semi-annually or after the passage of a designated number of miles. Engines and undercarriages are apparently cleaned only for inspections, to aid in the location of oil leaks, and when preparing vehicles for higher-ordered maintenance.

Unscheduled Maintenance

The number of unscheduled maintenance operations required by tactical equipment is difficult to predict. Data obtained from the 9th Infantry Division Artillery at Fort Lewis indicate that tracked equipment can be expected to require some sort of unscheduled maintenance approximately 40 times annually; unscheduled maintenance for wheeled equipment occurs approximately twice annually. In terms of total number of maintenance operations, these data indicate 44 maintenance operations per tracked vehicle and five operations per wheeled vehicle, annually. It is probable, however, that engine oils are changed infrequently during unscheduled maintenance operations. It is therefore assumed that engine and transmission oils are changed twice annually for tracked and wheeled equipment.

Waste Oil Production

The amount of waste oil generated annually at any given motor pool was estimated by determining the composition and service requirements of the vehicles from each unit assigned to a motor pool and applying a factor to account for oils consumed during vehicle operation or retained internally within engines, transmissions, and filters. To estimate the relative magnitude of the quantity of waste oil produced by various units, crankcase and transmission oil capacities for the various vehicles listed in TM 9-500[3] were applied to vehicle counts obtained during a motor pool survey conducted at Fort Lewis in 1977.

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[3] Data Sheets for Ordnance Type Material, Technical Manual 9-500 (Headquarters, Department of the Army, 1967).

Tables 1 and 2 list information on crankcase and transmission oil capacities, as well as cooling system characteristics for various types of tracked and wheeled equipment. It is apparent from these tabulated data that new and waste oil handling for tracked equipment has the most potential for creating serious oil pollution-control problems if adequate facilities are not provided in the motor pools to which these vehicles are assigned. Table 3 is a compilation of unit vehicle counts obtained from the Fort Lewis motor pool survey. Data in Tables 1 through 3, used in conjunction with the anticipated oil changing frequency, provide an estimate of the annual oil usage for various tactical units for which vehicle counts are available. Assuming that 80 percent of new oil appears as a waste product,[4] an estimate of the annual waste oil generated by these units can be computed (see Table 3). Although, in general, these data cannot be used to determine the waste oil storage requirements at a given motor pool, they do serve to identify those units for which new and waste oil handling operations and facilities are of particular importance.

Existing Oil-Changing Facilities and Waste Oil Handling and Storage Equipment

Wheeled Equipment

Oil changing for wheeled equipment is performed on one or more elevated grease racks located within the motor pool hardstand area or, at some motor pools, at service pits located within the shops. The latter facilities confine oil spillage to well-defined areas, thereby preventing the possibility of oil-contaminated storm water. However, these pits, when not in use, may constitute a safety hazard.

The use of existing outdoor grease rack facilities for wheeled vehicle oil changing operations poses problems with respect to prevention of oil contamination of storm waters and the efficient collection of waste oils. Since most of these facilities are uncovered, they are subject to storm water intrusion from adjacent hardstand areas, and, in general, are not equipped to handle or store waste oils.

Tracked Equipment

There are no known oil changing facilities specifically designed for handling and storing waste oils from tracked equipment. Oil can be changed only within those shops equipped with overhead cranes. Where overhead cranes are not provided, oil must be changed on the hardstand, using retriever-type equipment.

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4 A Technical and Economic Study of Waste Oil Recovery, Parts IV, V, and VI, PB251716 (U.S. Department of Commerce, Teknekron, Inc., October 1975).

Table 1

Characteristics of Various Types of Track-Laying Vehicles

Designation	General Description	Mode of Engine Cooling	Cooling Capacity, Qt (L)	Crankcase Capacity, Qt (L)	Transmission Capacity, Qt (L)
M48A1	Tank,combat,90 mm	Air	--	72(68.4)	92(87.4)
M48A2/A2C	Tank,combat,90 mm	Air	--	64(60.8)	92(87.4)
M48A3	Tank,combat,90 mm	Air	--	48(45.6)	76(72.2)
M60/60A1	Tank,combat,105 mm	Air	--	48(45.6)	76(72.2)
M107	Gun,self-prop,175 mm	Liquid	NA	26(24.7)	57+(54.2)
M110	Howitzer,self-prop,8-in.	Liquid	NA	26(24.7)	57+(54.2)
M109	Howitzer,self-prop,155 mm	Liquid	NA	28(26.6)	52+(49.4)
M108	Howitzer,self-prop,155 mm	Liquid	NA	26(24.7)	58+(55.1+)
M42/42A1	Gun,Anti-aircraft	Air	--	44(41.8)	44(41.8)
M56	Gun,self-prop,90 mm	Air	--	11(10.5)	15(14.3)
M53	Gun,self-prop,155 mm	Air	--	104(98.8)	96+(91.2+)
M55	Howitzer,self-prop,8-in.	Air	--	64(60.8)	72+(68.4+)
M37	Howitzer,self-prop,105 mm	Liquid	NA	16(15.2)	30+(28.5+)
M52/52A1	Howitzer,self-prop,105 mm	Air	--	44(41.8)	49(46.6)
M44/44A1	Howitzer,self-prop,155 mm	Air	--	44(41.8)	70(66.5)
M84	Mortar,self-prop,107 mm	Water	56(53.2)	22(20.9)	56(53.2)
M728	Vehicle,combat engr, 165 mm	Air	--	NA	68(64.6)
M5 - M5A4	Tractor,high speed	Water	80(76)	22(20.9)	48(45.6)
M8A1 - M8A2	Tractor,high speed	Air	--	44(41.8)	72(68.4)
M6	Bulldozer,tank mounted	Air	--	64(60.8)	80+(76+)
M8	Bulldozer,tank mounted	Air	--	72(68.4)	92(87.4)
M9	Bulldozer,tank mounted	Air	--	48(45.6)	76(72.2)
M578	Recovery vehicle	Water	96(91.2)	26(24.7)	NA
M88	Recovery vehicle	--	--	64(60.3)	72(68.4)
M113	Armored personnel carrier	Water	40(38)	10(9.5)	16(15.2)
M577 - M577A1	Armored personnel carrier,	Water	38(34.2)	12(11.4)	12(11.4)
	command post		38(36.1)	18(17.1)	

NA -- not available

Table 2

Characteristics of Various Types of Wheeled Vehicles

Designation	General Description	Cooling System Capacity, Qt (L)	Crankcase Capacity, Qt (L)
M170	1/4-ton ambulance	11.5(10.9)	5 1/2(5.2)
M43 - M43B1	3/4-ton ambulance	17(16.2)	5(4.8)
M44,M45,M46, M46C,M58,M133, M207,M207C	2-1/2-ton truck chassis	22(20.9)	9(8.6)
M34,M36,M36C	2-1/2 ton truck chassis	44(41.8)	18(17.1)
M40,M40C,M61, M63,M63C,M139, M139C,M139D	5-ton cargo	22(20.9)	9(8.6)
M135,M211,M35	2-1/2-ton cargo truck	22(20.9)	11(10.5)
M41,M54,M54A1, M54A2,M55	5-ton cargo truck	44(41.8)	22(20.9)
M125	10-ton cargo truck	66(62.7)	22(20.9)
M342	2-1/2 cargo,dump	22(20.9)	10.5(10.0)
M51	5-ton dump	44(41.8)	22(20.9)
M49,M49C	2-1/2-ton gasoline	22(20.9)	9(8.6)
M217,M217C	2-1/2-ton fuel servicing	22(20.9)	9(8.6)
M150,M222	2-1/2-ton water	22(20.9)	9(8.6)
M48,M221,M275	2-1/2-ton truck tractor	22(20.9)	9(8.6)
M52,M52A1	5-ton truck tractor	44(41.8)	22(20.9)
M123,M123C,M123D	10-ton truck tractor	66(62.7)	22(20.9)
M246	5-ton wrecker	44(41.8)	22(20.9)
M38,M38A1,M38A1C	1/4-ton utility	115(10.9)	4(3.8)
M151	1/4-ton utility	8(7.6)	4(3.8)
M108,M60	2-1/2-ton wrecker	22(20.9)	9(8.6)
M62,M62E1	5-ton wrecker	44(41.8)	18(17.1)
M512,M512C,M512D M512F,M512G	2-1/2-ton shop vans	22(20.9)	9(8.6)

Table 3

Estimated Waste Oil Generated Annually by Various Tactical Units

Unit Designation	Vehicle Track	Counts Wheeled	Estimated Waste Oil Generated Gal (L)*
Cavalry Squadron	36	43	800 (3032)
Artillery Battalion (BN) (inf div)	0-5	91-111	400-900 (1516-3411)
Air Defense Artillery BN	44	115	900 (3411)
Military Police group (GP)		54	100 (379)
Ordnance CO	2	46	400 (1516)
Transportation CO		70-73	300-600 (1137-2274)
Adjutant General CO		29	100 (379)
Signal BN		160-222	600 (2274)
Engineer BN	12-18	214-213	800-1700 (3032-6443)
Military Intelligence GP		21	100 (379)
Armored BN	94	78	3400 (12,886)
Mech inf BN	88	91	900 (3411)
Medical GP	108		300 (1137)
Infantry BN		116	300 (1137)
Supply & Transport CO		123	600 (2274)
Aviation BN		46	200 (758)

*Rounded to next highest 100 gal (379 L).

Existing Waste Oil Handling and Storage Equipment

The waste oil handling equipment at the majority of Army motor pools consists of 55 gal (209 L) drums cut horizontally or vertically; these drums may or may not be provided with handles. Waste oils are manually transferred from these drums to waste oil handling tanks at one or two locations on the hardstand. The holding tanks generally consist of 500 gal (1895 L) drums located above or below ground. Access to holding tank is usually by means of a 2-in. (51-mm) pipe. Such waste oil handling procedures and equipment virtually guarantee that large quantities of waste oil will be spilled or otherwise disposed of in a manner unacceptable under current environmental regulations.

Maintenance Cleaning Operations and Resultant Wastewater Characteristics

Maintenance cleaning operations, such as engine pack, engine compartment, and wheeled vehicle undercarriage cleaning, are performed either in shops equipped with functioning floor drains or at the washrack facility. Generally, steam cleaners are used in these operations, if they are authorized and available. When the washrack facility is used for maintenance cleaning, it is probable that unauthorized cleaning agents such as diesel fuels, solvents, and store-bought cleaners are used to facilitate removal of grit and grime.

Not all motor pool maintenance cleaning operations are water-based. At Fort Lewis, the shop occupied by an armored battalion is equipped with a solvent washer for degreasing small parts; however, since no slop sump is provided, spent solvent is disposed of by dumping the waste down the shop drain. At Fort Carson, the gun tubes of howitzers were cleaned after each firing with standard gun bore cleaner until it was found that hydraulic fluid did a more efficient cleaning job. The Fort Carson operations are carried out exclusively at the washrack or in the adjacent hardstand area.

In contrast to simple washing operations in which exterior and interior soil is removed, wastewaters from maintenance cleaning operations can be expected to possess high organic content, surfactant concentrations, and grease and oil concentrations, as well as residual fuels, solvents, and volatile and inert suspended materials. It is also possible that these wastes may at times contain certain constituents that, if present in sufficiently high concentrations, could not be discharged into the sanitary sewer system. The consideration of these and other factors is necessary for the proper design or selection of a pretreatment unit to service facilities receiving wastewaters from maintenance cleaning operations.

3 CONCEPT PLANS FOR IN-HARDSTAND MAINTENANCE FACILITIES FOR TACTICAL EQUIPMENT

Tracked Equipment

The concept plan for in-hardstand maintenance facilities for tracked equipment is based on the premise that the engine packs of most tracked equipment are removed from the vehicles as part of the oil change operation. A facility layout capable of meeting tracked equipment requirements for oil changing, engine cleaning, engine compartment cleaning, and general inspection cleaning is shown in Figure 1. This facility, which can be built in either one- or two-bay configurations, essentially consists of four functional areas:

1. An engine compartment cleaning area

2. An engine cleaning and waste oil drainage area

3. A sidewalk area containing the necessary cleaning equipment and waste oil holding tanks

4. A centrally located cleaning wastewater pretreatment area.

To prevent storm water from adjacent hardstand areas from entering the system, the entire facility is elevated above the general hardstand surface. One or two steam cleaners or hot water washers are provided per maintenance bay. Since pretreated cleaning wastewaters are to be discharged to the sanitary sewer, biodegradable cleaners approved and issued by the installation facility engineer or the Directorate of Industrial Operations can be used to facilitate cleaning operations.

Operational Sequence

The operational sequence for the facility is as follows:

1. A tracked vehicle requiring maintenance is driven onto the maintenance platform.

2. The engine pack is removed from the vehicle by means of an M578 or M88 retriever.

3. The engine pack is placed on an engine pack dolly provided as part of the engine oil change/engine cleaning area.

4. The engine compartment and all dirty surfaces are cleaned prior to vehicle maintenance using the cleaning equipment in the engine compartment cleaning bay.

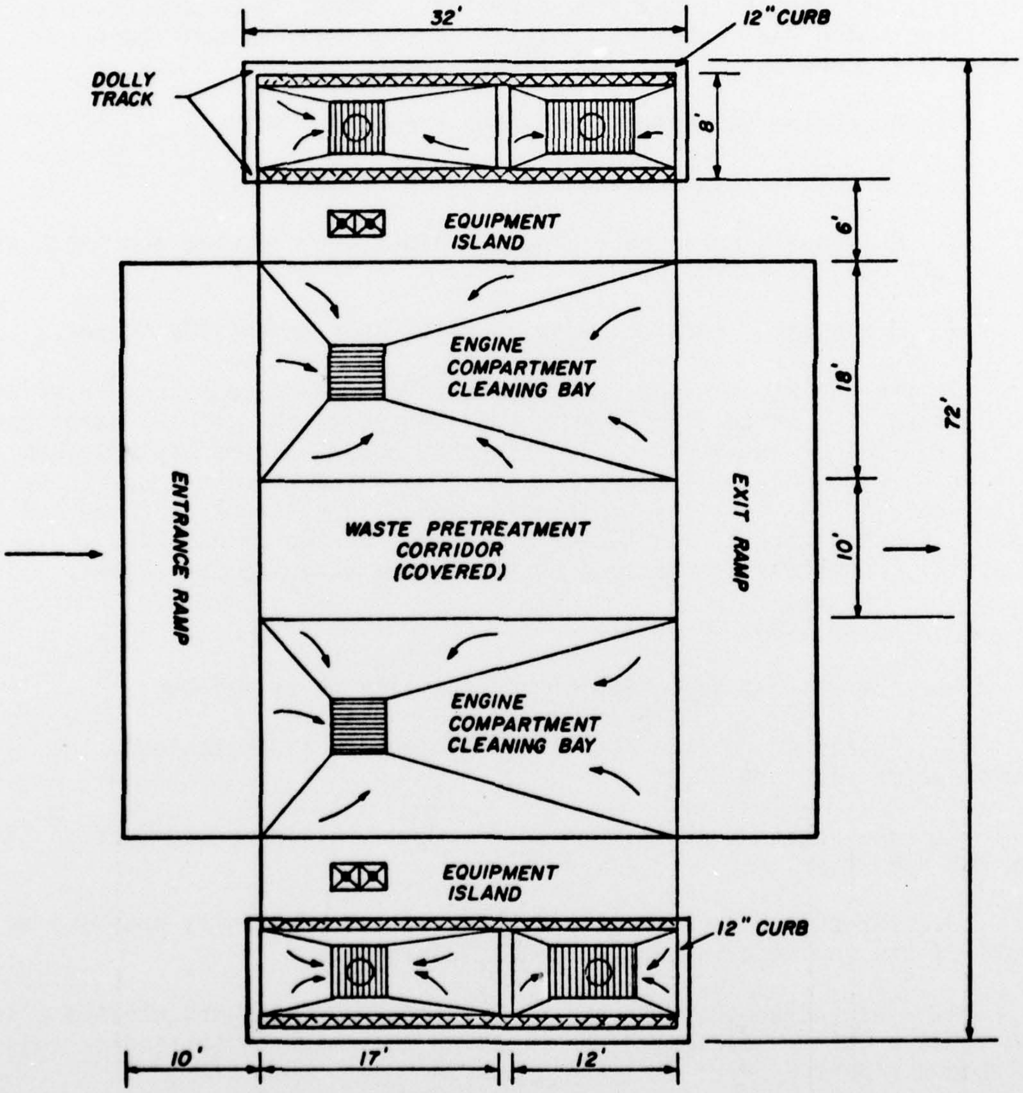


Figure 1. Concept plan -- tracked vehicle maintenance platform for permanent motor pools.

5. The engine pack, which has previously been placed on the engine pack dolly, is cleaned over the larger of the facility's two sumps.

6. The engine pack dolly is moved over the oil change sump used for oil removal and engine oil is replaced.

7. Final drive oils are removed by hand from the final drive assemblies and discharged directly into the waste-oil holding tanks through access ports located within the equipment islands.

8. The vehicle is either towed off the platform and reunited with its engine pack or both the vehicle and engine pack are transferred to the shops for further processing.

A process flow diagram and time study for operation of this facility is shown in Figure 2. The time study indicates that a single bay facility could process one tracked vehicle every 90 minutes. (This rate was crosschecked with prospective users at Fort Carson and Fort Lewis and judged to be realistic.)

Waste Oil Storage and Wastewater Collection

Waste oil storage facilities must be sized to accept all waste oils (1) discharged into the oil changing sump, (2) discharged from the equipment island access ports, and (3) skimmed periodically from the oil/water separation unit. An underground waste oil storage tank can be provided either within the boundaries of each equipment island or at a site immediately outside the maintenance platform area to collect waste oils. Although the size of the holding tank will depend on the maintenance characteristics of the unit being serviced and the desired waste oil collection frequency, it is recommended that a tank with a capacity of not less than a 1000 gal (3790 L) be used with each maintenance bay.

Cleaning wastewaters are generated at each engine cleaning station and engine compartment cleaning bay. As low-flow cleaning equipment is provided (4 gpm or 15.2 L/m per cleaner), it is anticipated that there will be a problem with transporting solid matter from the engine compartment cleaning bay to the pretreatment unit. However, the transport of solids can be facilitated by connecting the catch basin of the engine compartment cleaning bay to the receiving chamber of the pretreatment unit by means of a chute set at a slope of no less than 4 percent. Problems with solid transport from the engine cleaning station to the pretreatment unit are not anticipated, as these wastewaters should contain a minimum of inert solid matter.

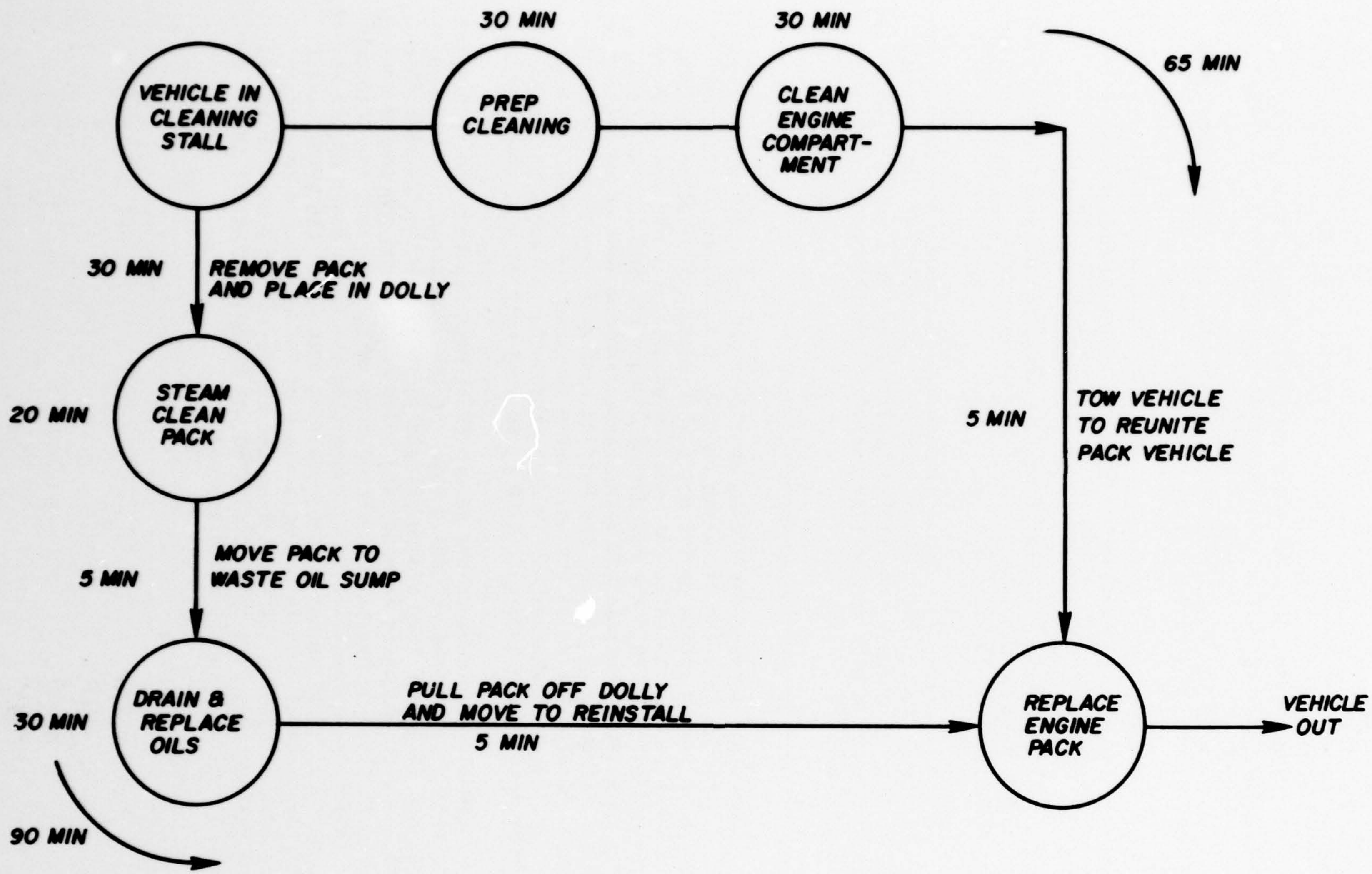


Figure 2. Process flow diagram -- time study.

Wheeled Equipment

The concept plan for meeting the service requirements of wheeled equipment provides separate areas for oil changing and for cleaning operations such as undercarriage cleaning, engine cleaning, and radiator flushing.

Oil Changing and Waste Oil Storage

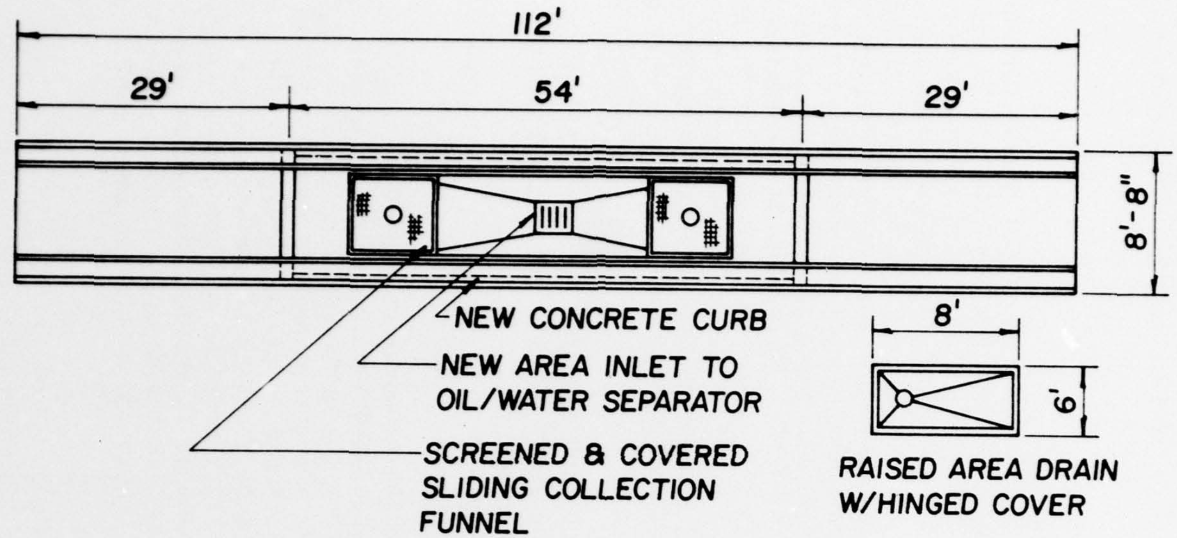
In general, it is proposed that each motor pool grease rack be outfitted with two track-mounted waste oil collection funnels, as shown in Figure 3. The screened and covered collection funnels are connected by a flexible hose to an underground waste oil storage tank with a minimum capacity of 500 gal (1895 L). In addition, a covered waste oil inlet structure is provided in this same area for the disposal of waste engine oils from those types of equipment that cannot be serviced on a grease rack. The covered waste oil inlet structure is directly connected to the underground waste oil holding tank. To prevent oil contamination of storm waters, a concrete curb is set around the perimeter of the horizontal area of the grease rack. Rainfall accumulations in the bermed area are removed by means of an area drain that discharges to an oil/water separator. Effluent from the separator is subsequently discharged to the sanitary sewer.

Facilities similar in concept to the wheeled vehicle waste oil handling system described above are currently in service both at Fort Carson, CO, and Fort Bragg, NC.

Maintenance Cleaning Facilities

The concept plan for providing maintenance cleaning facilities for wheeled equipment requires the construction or conversion of one permanent grease rack facility within the motor pool for undercarriage cleaning. As shown in Figure 4, the grease rack is bermed and provided with an area drain discharging through an oil/water separator to the sanitary sewer. Cleaning equipment consists of one steam cleaner or hot water washer. Ideally, the facility would be covered with a canopy. In addition, an auxiliary raised washpad is provided for engine cleaning and radiator flushing in the event that a separate tracked vehicle maintenance platform facility is not required within the motor pool.

STANDARD CONCRETE GREASE RACK



NOTES:

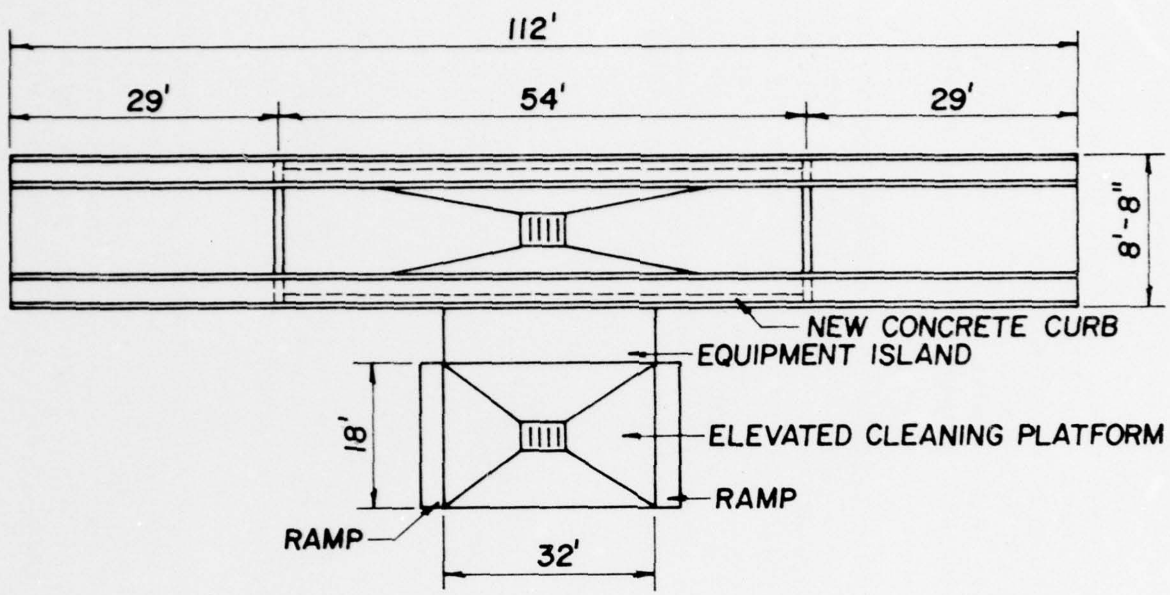
1. SLIDING COLLECTION FUNNELS CONNECTED BY FLEXIBLE HOSE TO 1000 GALLON UNDERGROUND WASTE OIL STORAGE TANK.

2. RAISED AREA DRAIN, TO BE USED FOR OIL CHANGING IN TRACKED EQUIPMENT, DISCHARGES TO UNDERGROUND WASTE OIL STORAGE TANK.

3. AREA INLET AND OIL/WATER SEPARATOR NOT REQUIRED IF GREASE RACK IS COVERED.

Figure 3. Motor pool grease rack outfitted with two track-mounted waste oil collection funnels.

STANDARD CONCRETE GREASE RACK



NOTES:

1. FACILITY TO BE PROVIDED WITH ONE HOT WATER WASHER.
2. EQUIPMENT ISLAND CONTAINS WASTEWATER PRETREATMENT UNIT. EFFLUENT DISCHARGE IS TO SANITARY SEWER.
3. GREASE RACK AREA MAY BE PROVIDED WITH A CANOPY.

Figure 4. Bermed grease rack.

4 WASTEWATER TREATMENT CONSIDERATIONS

Wastewaters generated at the proposed in-hardstand maintenance cleaning facilities can be expected to contain highly variable concentrations of floatable oil and grease; emulsified oils; light hydrocarbons, such as gasoline and solvents; biodegradable and possibly non-biodegradable organic fractions; volatile and inert suspended matter; and surfactants from detergent usage. However, introduction of hot water washes or steam cleaners should curtail solvent usage during maintenance cleaning operations by allowing solvents to be replaced with biodegradable cleaners and detergents. In addition, this equipment will keep process waste flows to a minimum, allowing storm water flows to generally govern the hydraulic design of the wastewater pretreatment system.

Since these pretreated wastewaters, including storm-induced flows, are to be discharged into an installation's sanitary sewer system, the hydraulic and waste treatment capabilities of the sanitary sewer system must be considered in relationship to the total number of maintenance facilities to be provided. This factor, together with the as yet unquantified characteristics of cleaning waste streams, must necessarily limit the discussion of waste pretreatment alternatives to an overview of the general requirements for pretreatment facility design.

General Requirements

Pretreatment units servicing the maintenance facilities described in this report must be designed to produce an effluent capable of being discharged to the sanitary sewer without adversely affecting that system's performance. In this regard, it has been found that trickling filter plants can treat influent oil concentrations of up to 100 mg/L without upset, but that activated sludge plants require that influent oil concentrations be maintained at levels below 25 mg/L.[5] Therefore, this study arbitrarily selected a conservative maximum oil concentration of 100 mg/L as the total oil allowable in the effluent from the pretreatment unit.

Suspended solids concentrations from the pretreatment units should be kept at levels that will not clog intervening sewer lines or overload the waste treatment plant's grit chambers or primary treatment facilities. A compilation of the raw suspended solids concentrations in the influent waste streams of 57 sewage treatment plants indicates that the average raw suspended solids concentration is 230 mg/L with a high and

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[5] Tabakin, R. B., R. Trattner, and P.N. Chervemisinoff, "Oil/Water Separation Technology: The Options Available, Part 2," Water and Sewage Works, Vol 125 (August 1978), pp 72-75.

low concentration of 577 mg/L and 110 mg/L, respectively.[6] Therefore, this study selected suspended solids concentration in the range of 150 to 200 mg/L as the maximum allowed from the pretreatment units.

No general statement can be made with respect to limiting concentrations of dissolved organics to be placed on the effluents from pretreatment units servicing these facilities. Effluent limitations, if any, will ultimately depend on (1) the nature and concentration of organics in the wastes produced by the facilities, and (2) the degree of dilution afforded by the general domestic wastewater flow. If it is found that the organic loading contributed by these sources is significant in comparison with the average organic loading from domestic waste flows at the installation under consideration, it may be necessary to perform treatment studies to determine the extent to which the two waste streams are compatible.

General Requirements for Gravity Separation

In the absence of specific limitations on the discharge of organics to the sanitary sewer system, wastewater pretreatment would consist of removal of suspended solids and total oils (free plus emulsified) to the acceptable levels. Generally, this will require the use of a rectangular basin having areal dimensions and depth sufficient to remove flotable oils and suspended solids to the desired levels, while providing for sludge and oil storage and removal. If necessary contaminant reductions cannot be achieved through gravity separation, either some form of filtration or a dissolved air flotation system (with or without the use of chemicals) would be indicated. However, such alternatives would not be desirable from the standpoint of waste treatment unit maintenance.

On the assumption that gravity separation alone would be sufficient to produce the effluent quality desired, preliminary design criteria for suspended solids and floatable oil removal are presented in Table 4. These criteria are based on American Petroleum Institute recommendations[7] for removal of oil droplets to 150 microns in diameter, and supplemented by the technical literature and limited experimental data obtained during this study on the quiescent settling characteristics of various soils at suspended solids concentrations ranging from 500 mg/L to 2000 mg/L.

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[6] ASCE -- Manuals of Engineering Practice No. 36, Sewage Treatment Plant Design (ASCE, 1959), pp 90-91.

[7] Manual on Disposal of Refinery Wastes, Volume on Liquid Wastes (American Petroleum Institute, 1969).

Table 4

Design Criteria for Gravity Separation

Overflow rate[1]: 100 to 900 gpd/ft^2 (0.4 to 3.6 Lpd/cm^2)

Detention time[2]: 1-6 hours

Length to width ratio: 3 to 1 (minimum)

Total depth: 4 ft minimum (91 cm)

Mean horizontal velocity: 3 fmp maximum (1.5 cm/sec)

Oil storage within basin: 1000 gal minimum (3790 L)

Oil skimming: rotary pipe skimmer or portable external skimming device[4]

Sludge removal: integral sludge pump provided or sludge removed periodically by mobile vacuum truck

NOTES

1. Design overflow rate to be applied to flow produced under conditions of maximum flow, either process or storm water flow: The 10 year to 1 hour storm flow is suggested for in-design use if storm-induced flows must be considered.

2. Theoretical detention time provided, based on the basin volume over and above that volume assigned for sludge storage.

3. Depth of basin above that depth assigned for sludge storage.

4. Oil-mop portable skimmer or equivalent.

5 CONCLUSIONS

1. Waste-oil handling at Army motor pools can be improved by providing facilities which minimize manual handling of waste oils.

2. The collection and treatment of waste oils will be improved by restricting maintenance cleaning activities currently conducted at washracks to either motor pool shops or in-hardstand maintenance cleaning facilities using retrofit cleaning equipment.

In addition, preliminary design criteria are presented for the pretreatment of wastewaters from maintenance cleaning operations under conditions where the use of commercial solvents and diesel fuel is prohibited for cleaning purposes. As the organic loadings generated by these operations are presently unknown, these criteria must be verified or modified by experimental testing.

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